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Held in connection with

The GREAT INTERNATIONAL FISHERIES EXHIBITION

FISH PRESERVATION

AND

REFRIGERATION

BY

MR. J. K. KILBOURN

LONDON
WILLIAM CLOWES AND SONS, LIMITED
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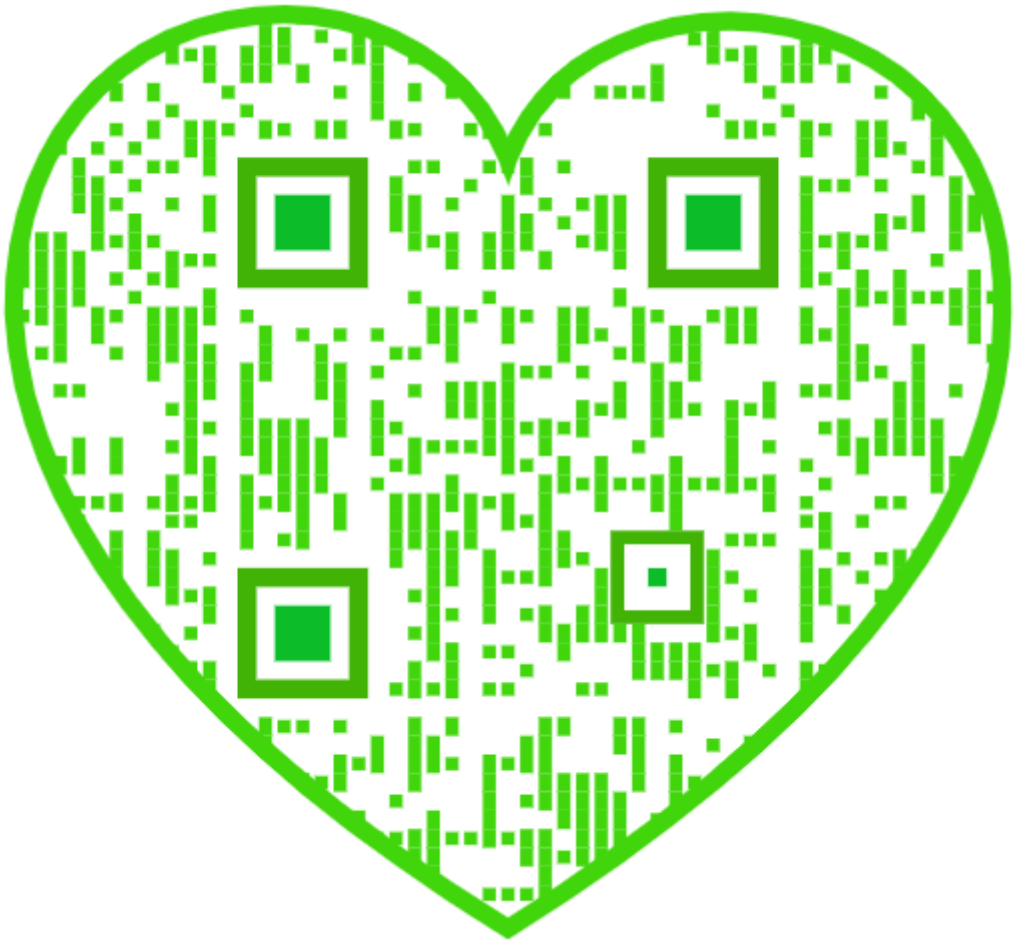

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International Fisheries Exhibition

LONDON, 1883

FISH PRESERVATION

AND

REFRIGERATION

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MR. J. K. KILBOURN

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1883

International Fisheries Exhibition,
LONDON, 1883.

CONFERENCE ON THURSDAY, OCT. 25, 1883.

Mr. S. WILMOT (Commissioner for Canada) in the Chair.

FISH PRESERVATION AND REFRIGERATION.

THE recent and persistent efforts to break up the Billingsgate monopoly; the establishment of new fish markets at Elephant and Castle and Smithfield, and the reopening of the Columbia Market; and, crowning all, the International Fisheries Exhibition, already visited by more than 2,000,000 persons, gives emphasis to the interest now evinced by the public in all matters relating to the subject of fish supply, and adds to the importance of any information pertaining thereto.

The subject-matter of this paper relates to the preservation of fish by conditions of temperature, but that this may be more clearly understood it will be well to first consider the nature of the disorganising process we wish to combat, and to briefly trace the steps of the investigators that have led to the now generally accepted belief that all putrefactive action is caused by living organisms. This theory of putrefaction has taken half a century for its development, but it has not met with the hearty and prompt recognition due to its importance.

Schwann, of Berlin, was the first to prove that living germs are the cause of putrefaction, and in 1837 he made the important announcement that when a decoction of meat is

effectually screened from ordinary air, and supplied solely with calcined air, putrefaction never sets in.

Putrefaction, therefore, he affirmed to be caused not by the air, but by something in the air which could be destroyed by a sufficiently high temperature.

These results by Schwann were confirmed by the experiments of Helmholtz in 1843, by Schroder and Von Dusch in 1854, by Schroder alone again in 1857, and by Pasteur in 1862.

Experiments by Prof. Tyndall in 1868–9 went to show that ultra-microscopic matter in the air was made visible by a concentrated beam of light, and by the same test he found that air that had been passed over the flame of a spirit-lamp was optically pure, and when in this condition that it had lost its power to generate life, and in this manner gave complete confirmation to the announcement by Schwann thirty years before. Tyndall's experiments extended through several years, and demonstrated beyond a doubt that infusions of meat, fish, and vegetables sterilized by heat, and freed from contact with common air, never putrefies, while the same infusions exposed to common air were teeming with life in two or three days.

In these experiments by Tyndall it was shown that the rapidity of putrefactive development in infusions infected by a speck containing Bacteria (developed germs) was something extraordinary. The development in twelve hours, with an infusion so infected, was equal to several days' exposure where the infusion was only exposed to air germs. This is most important, and should be noted, as it will be referred to again, later on. It was also found that a certain amount of oxygen was necessary to sustain Bacterial life, while, on the other hand, experiments by Paul Burt, proved conclusively that an excess of oxygen under pressure would kill Bacteria.

In 1872 Cohn of Breslau announced that " putrefaction begins as soon as Bacteria, even in the smallest numbers, are introduced. It progresses in direct proportion to the multiplication of Bacteria. It is retarded when the Bacteria (for example by a low temperature) develop a small amount of vitality, and is brought to an end by all influences which either stop the development of Bacteria or kill them."

Having now set forth the generally accepted theory of the putrefactive process, and glanced at the successive steps of the different investigators that have led up to this belief, we may pass on to the subject-matter of this paper, viz. :—

Preservation by Conditions of Temperature.

" Putrefaction," says Cohn, " begins as soon as Bacteria, even in the smallest numbers, are introduced, and progresses in direct proportion to their multiplication," and it follows as a logical sequence that the different conditions between sound fish and rotten ones are but the different stages in the process of putrefaction.

Preservation, in the sense here used, at any temperature above 32° Fahrenheit, only retards this process ; below 32° it suspends it ; but in neither case can it restore a condition once lost. It is well known that freezing completely checks all putrefactive action, and when in this frozen condition meat or fish can be kept for an indefinite length of time. A noticeable instance of this was seen in the salmon brought from Labrador, in the s.s. *Diana* in 1881. A part of this cargo was taken from London to Australia, and after this long voyage across the tropics and 200 days out of water, these salmon were found to be in good condition.

If further evidence is required of the preserving power over extended periods by freezing, it can be had by examining the instructive exhibit at the Canadian Court, where fish in good preservation can be seen that have been out of the water for eighteen months. The advantages to be derived from this method of preservation, have not been nor are they now fully appreciated ; public opinion seems to have settled quietly into the belief of the oft-repeated statement that it "destroys the flavour of fish to freeze them," and that "they go bad so quick after they are restored to normal temperature." Neither of these statements are well founded, although they may be in accord with the observations of those who make them.

The flavour of a fish and its keeping quality after thawing, depend more upon its *condition* when frozen than upon the deleterious action of the low temperature in which it has been kept. It should be constantly borne in mind that there is *no* restorative power in any system of preservation.

Notwithstanding the great advantages of this method of preservation by freezing it has not yet been adopted to any considerable extent by the English fishermen.

It is not so readily applicable to the fishing boats and methods of fishing now in vogue, as the system of retardation by temperature a little above freezing ; and hereafter our remarks will refer to this branch of the system under consideration.

The present demand is for a system by which any fish caught in English waters can be delivered in any English market in sound condition, and at a cost that is not prohibitory. To what extent this demand can be practically met is somewhat conjectural, but that radical improvements over present methods can be made will not be questioned

by any one who has given the subject serious consideration.

Inasmuch as a temperature above freezing does not completely check, but only retards Bacterial development, it follows that the preserving effect can only be for a limited period. The duration of this period under the most favourable conditions is none too long, but it is in a measure dependant upon controllable causes, and these are worthy of careful consideration.

To extend this period to the utmost limit, it is of the very first importance that the preserving influence begins as soon as the fish are out of the water, and before deterioration sets in; in other words, the animal or natural heat should be withdrawn, and the fish cooled from surface to centre as quickly as possible.

This speedy cooling necessitates not only a low temperature, but room for spreading the fish, or appliances for separating them into layers so as to allow free circulation of the cooled air.

Absolute cleanliness in every department is of vital importance. You may as well lodge a perfectly healthy person in the bed of a small-pox patient as to pack freshly-caught fish in boxes or compartments contaminated with the filth and slime of previous putrefaction.

If any fisherman entertains a doubt upon this point, let him place a row of fish side by side, backs upwards, upon a filthy board in the bottom of his boat, and he will find that the bellies of these fish are completely rotten when the sides and back are apparently sound.

To secure the degree of cleanliness absolutely essential to prolonged preservation, it will be found advantageous to line all compartments where fish are packed with zinc or

galvanized iron, and to make all boxes or trays in which fish are moved of the same material. These with proper care can be kept sweet and clean, and the extra cost and trouble will be repaid tenfold in the improved condition of the fish.

The prevailing practice of piling fish *en masse* one upon the other to the depth of several feet is objectionable in every sense, but especially so before the fish are thoroughly cooled.

Water could hardly pass through such a pile of fish, much less would it be possible for air to permeate it. When the fish are thoroughly cooled, there would be less objection to packing in compact masses, but even then it should not be overlooked that the bony structure of a fish is not sufficient or suitable for supporting incumbent weight.

Packing fish in ice may be fairly considered as a choice of evils. Some fish, salmon for instance, appears to bear it better than others, but in no instance does it improve the quality or flavour. Fish in ice will, no doubt, keep longer than under the same external conditions without ice, but the point to determine is whether the quality of the fish cannot be improved without the sacrifice of the preserving period, by keeping them at or near an ice temperature without the direct contact with the ice.

The theoretic perfect system, will provide suitable appliances to avoid the frequent handling of the fish, which is now a part of the usual practice.

Its aim should be to deliver fish to the different markets with once handling after they are removed from the hook or net. If this object is not completely attainable, efforts in this direction will result in decided improvements over present practice.

The system of preservation now under consideration has 32 degrees, or the freezing point of the fish, for its minimum

temperature, and the question naturally arises, what is the maximum degree compatible with safety? Unfortunately this point has not been definitely determined.

The living organisms in Brewer's ferments have their activity suspended in a temperature below 50 degrees, but with Bacterial germs from 10 to 15 degrees lower would, it is believed, be necessary.

Fish, when in a perfectly sound condition, placed in a temperature ranging between 32° and 35°, will remain sound for a long time; but the range between 35° and 40° may, perhaps, be considered as debateable ground. The highest degree of temperature compatible with safety once determined, a constant temperature below this point will be found to be an essential requisite.

For a complete realisation of the possible advantages derivable from this system of preservation, it must not only begin before deterioration sets in, but it must also be continuous until the fish are delivered to the various markets for final disposal. This involves providing cold chambers in the cutters for transportation by water, cold storage on the docks, and refrigerating cars for land carriage. If these provisions in ample proportions are provided, the fisherman will be in a great measure independent of sudden changes in the weather and of fluctuations in market prices, and the fish-curer will have greater cause than now to complain* of his inability to procure fish at his own price of a quality that the fish merchants are compelled to sell.

If this system of preservation ended with the landing the fish on the docks, or in delivering them to the cutters in better condition than ever before attainable, it would then have no mean importance. But it does not end here, but

* An actual complaint.

can have practical application in the different methods of transportation by land or by water, and for this reason the subject of fish transportation, or fish preservation while in transit, may with propriety be considered in this Paper.

Refrigerating cars are important links in the chain forming the complete system of preservation, and will in the near future be considered a necessity for the transportation of perishable articles, but they cannot be endowed with the almost miraculous powers which many accredit them with. Exaggerated views of their capabilities are pernicious and misleading, and induce many fruitless attempts to solve the great problem of safe transportation of perishable articles. Speaking of them negatively, it is scarcely possible, certainly not economical, to convert cars into successful freezing chambers. The height and width of railway vans are restricted to fixed limits, and proper insulation will require 25 per cent. of the inside area, the appliances for holding sufficient ice to maintain a temperature against losses, but not including cooling the fish, will make a further requisition on the available space of 10 per cent.

The refrigerating power is from necessity derived from ice, and you not only have to pay for the ice so used, but also pay for its transportation, and it requires no further argument to show the folly of attempting to do that in the cars that can be better and cheaper done in fixed chambers. In illustration, we will assume that five tons of herrings, fresh from the water, with a natural temperature of 60° (outside temperature something higher), are placed in a car and started for London. If you obtain theoretic beneficial results in melting the ice (results which are never realized), it would take half a ton of ice to cool these fish to a temperature of 35°; practically, it would take at least 50 per cent. more than this without allowing anything for loss through the walls

and openings of the car. The ice, to effect this cooling, must be debited with not only its prime cost and cost of handling, but also with its transportation, which, if from the north of Scotland, would be, say, £4 per ton for quick trains, and £2 10*s*. if by goods trains.

This illustration is on the assumption that it is possible to do this cooling in the car in the time necessary to save the fish ; but this is scarcely possible, and there would be no certainty of getting the fish to market in a sound condition, and in every case the cost would be excessive if not prohibitory. It has been shown that the space inside the car must necessarily be reduced 35 per cent., and to carry sufficient ice to cool the fish, in addition to that required to maintain the temperature against losses, would still further reduce the space, and add not less than 15 per cent. to the weight of the load that has to be paid for, to the exclusion of an equal weight of fish.

With a car properly insulated, and with suitable appliances for containing the ice and collecting the deposited moisture, a low temperature may be maintained against the continuous losses ; more than this is impracticable, and if attempted will inevitably result in loss and disappointment.

In brief review, it has been shown that the disorganising forces that cause all putrefaction, are minute living organisms invisible to the naked eye. That these organisms multiply with extraordinary rapidity in favourable conditions of heat and moisture, that their development is materially retarded in temperatures between 32° and 40°, and is entirely suspended in any temperature below the point of congelation.

In the destructive attacks of these organisms against dead tissues, sooner or later the living forces will prevail. Preservation, therefore, resolves itself into the question,

How long, and by what means can these disorganising forces be kept quiescent?

In answer to this question I have before stated, and deem it of sufficient importance to repeat, that the fish, as soon as out of the water, should be thoroughly cooled from surface to centre, and as quickly as possible, to a point that will effectually check the development of these destructive germs. I have also stated that scrupulous cleanliness in every department is of vital importance; failing in this, you infect the fish with developed Bacteria, and accelerate putrefaction by many hours, if not by days.

The inconsistency, one might almost say the absurdity, of taking ice from the shore to preserve the fish, and at the same time take the ripened germs of contagion to destroy them, will be apparent to every one who rightly understands this disorganising process.

To secure the degree of cleanliness necessary, metal linings to the storage compartments, and metal boxes for holding and handling the fish, were recommended.

Piling fish one upon another tends to shorten the period of preservation, and frequent handling impairs the quality.

It will be an important point gained to be able to land fish in better condition than ever before attainable, but no system can be considered as completely successful unless it includes the delivery of the fish in a sound condition to the various markets for final disposal, less than this will not fulfil the public requirements.

To bring fish fresh from Ireland or the north of Scotland, will require an organised system, complete in every detail, and the preserving influence must be continuous from ocean to market.

Did time and the limits of this paper permit, detailed

description of the requisite arrangements would show that the system outlined is not by any means an impracticable one or difficult to put in operation. It was not brought to your attention in the belief that it was a new discovery, nor that it would be revolutionary in its operation ; but solely in the endeavour to contribute in a small degree to the fund of practical information relating to Fish Supply.

Thanking you, Gentlemen, for your patient attention, I would, in conclusion, express the hope that the views I have set forth will provoke discussion, especially upon the point of packing fish in ice, and that they may also induce experiments to determine the maximum degree of temperature compatible with safety.

DISCUSSION.

Mr. KENNETH CORNISH said he had paid a good deal of attention to this subject, and the question of chilling or freezing fish had also come under his consideration. Mr. Kilbourn would be right in protesting against the practice of absolutely freezing, because the result was to cause the water in the fibrillæ of the muscles to expand, which burst and set free the juices as soon as thawing commenced. This was the reason why meat which had been frozen went bad so rapidly. What was proposed was perfectly practicable, and he believed the new processes for the purpose would probably be brought forward as soon as the new Patent Act came into operation. The amount of cold required could, he believed, be regulated to a degree which at present there was no means of doing. From experiments he made, he came to the conclusion that the proper limit

would be between freezing-point and about four degrees higher. There was another advantage in dealing with meat not absolutely frozen, that you minimised the evaporation which went on to a considerable extent when meat was frozen, as could be seen by any one who examined the splendid samples in the Canadian Court. He thought the Norwegian stove might be adopted with great advantage in the formation of chambers in which meat or fish was kept. The practice of bringing it in contact with ice resulted in rendering it more flabby or flavourless, but if put in chambers of this kind there would be no occasion to change the air, and there would be less loss by evaporation. He saw no reason why flowers, meat, animal, and vegetable substances in general should not be kept from four to five months without serious deterioration. About eighteen years ago he made an experiment in trying to preserve meat by complete exhaustion of air; he had a rat and put him in an india-rubber package, and exhausted the air with a powerful pump. This was in July, and at the end of August he opened the package, and put in another rat freshly killed by the side of it; the rat freshly killed putrefied long before the other did, but for various reasons he did not think this method would be practicable on a large scale. He thought it was quite practicable to bring animal substances from all parts of the world by the process of chilling, but a good deal had yet to be done in the mechanical and scientific details. Another point which Mr. Kilbourn had not touched upon was the possibility of depriving animal substances of their water without injury to the albumen or ozmazone or juices, or altering the flavour, and he believed he had found a practicable solution of the problem, but he was waiting for the new Patent Act to make it public.

Mr. ALWARD (Grimsby) said it had given him great pleasure to listen to this Paper, and wished it was practicable to carry out the proposed scheme; but, as a practical fisherman, he did not think it was—to any great extent, that is to say — applicable to the North Sea trawl fisheries generally, from which the greatest supply was received. Several attempts had been made with a view of preserving fish in that branch of the fishing industry, but they had all failed. As they had heard, there was a difficulty when dealing with fish in bulk. The cold would either not penetrate through the bulk of the fish at all, or not to a sufficient extent to destroy the chemical action which was going on. But if the fish had to be separated one from the other, he was afraid it could never be brought into practical use to a large extent. With very elaborate contrivances, such as were found in ships fitted up for the purpose of bringing meat from distant parts of the globe, it might be practicable to preserve animal substances; but to apply it to the fisheries of this country was a very difficult question, unless some new discoveries were made, or the present system was much improved upon. He had salmon in a complete state of preservation, but there the conditions were more favourable, and salmon was a solid fish, very different from the majority of that which was caught in the North Sea, which consisted of a great deal of water, which could not be extracted without destroying the fish. They had been trying to substitute refrigerating apparatus for the ordinary method of preserving in ice, which was now carried out to a large extent; but he feared, until some further improvements were made, they would have to be content with the present system. He quite endorsed what Mr. Kilbourn said about cleanliness and the lining of boxes and houses, where fish were

stowed, with metal would be very useful. He had hoped to hear something new, for the ordinary refrigerating apparatus, he was sorry to say, had totally failed. Several vessels from the port of Grimsby had been fitted up with the view of preserving their own cargo in a semi-isolated condition, but without success, for although they were able to prevent decomposition, the fish were practically destroyed for marketable purposes, they had such a wizened and disagreeable appearance. With cod, ling, and fish of that kind, a great deal of the appearance of the fish depended upon the eye, and if it were frozen into a solid mass of ice, the fish had just the same appearance as if it were stinking. Unless you could preserve the brightness of the eye and the fresh appearance of the gills, the fish would not be saleable. He was very pleased to find that this subject was engaging the attention of gentlemen who had the means and ability to improve upon the present system, because an immense amount of waste constantly went on in the fisheries of which the general public had very little conception.

Mr. F. N. MACKAY said he had been connected for some years with artificial refrigeration, and he should like to say a few words on the points raised by the last speaker. Of course the most important point was the bringing of the article to market in a state as nearly as possible similar to that in which it was taken out of the water; and the description they had just heard of the state of the fish after having been frozen was practically that of a fish which had been to a certain extent decomposed. He believed that to be due to excessive freezing. He would point out that at Stand 720 in the Exhibition was shown, on a small scale, an apparatus devised for the purpose of meeting this want, namely, that of cooling the fish in its watery state without

freezing. It had been stated that it was necessary in order to accomplish this object that each fish should be separate from its neighbour in order that the air might circulate about it; but he would throw out the suggestion that air was a very bad conductor of heat, and it had the effect of destroying for market purposes what it had preserved. If the fish were packed to a certain extent in bulk, and were allowed to come in contact with cold surfaces of galvanised iron, which could easily be kept at a temperature of 35°, the fish was in actual contact with the cold surface, and the watery particles between acting as conductors would in a short time make the fish of uniform temperature without freezing it. The salt water brought in with the fish would also tend to prevent ice being formed, and a temperature of 30°, or even 28°, might be obtained without actually forming frost on the fish. This would prevent the drying-up of the fish, and would certainly stop putrefaction, and enable it to be brought to market in the desired condition. In the exhibit was shown, as an example of what was proposed to be put on a steam trawler, the machine itself being driven by steam. There were compartments 3 feet square, composed of hollow metal walls, through which the refrigerating brine for the machine was circulated at a temperature of 20° to 25°. These compartments had been kept at a temperature of from 30° to 32° throughout the Exhibition. This machine had not yet been applied to a trawler, as it had only lately been designed, on the suggestion of certain gentlemen of Hull, Grimsby, and Edinburgh. The distinguishing feature of the apparatus was that it did not cool the air and make the air the means of abstracting heat; but the fish itself was used as a conductor, and in this way the temperature could be regulated with the greatest facility. Machinery on the same principle had been devised for

cooling chambers used in breweries, and had proved very successful.

Mr. HESKETH said he had carried out several experiments at Messrs. Hall's works at Dartford with regard to the preservation of fish, and the results did not entirely tally with what was said by Mr. Alward. About half a ton of fish was sent up from Grimsby packed in the ordinary way with ice, and immediately on its arrival it was placed in a chamber cooled by cold-air machinery, where it was kept at a temperature of about 25° for six or seven weeks. At the end of that time the principal part of the fish was sent back to Grimsby, and was there pronounced to be in very good condition. The small portion which was kept was sent round to his personal friends, and he ate some himself, and none of them were able to discover any difference between it and perfectly fresh fish. Mr. Mackay remarked that the freezing process had the effect of drying the fish, but he could not see how that could be, the fish being frozen immediately they were placed in the cold chamber, so that hardly any time was allowed for the moisture to get out of them. With regard to the process described by that gentleman, he fancied there would be a difficulty in getting the fish cooled down in bulk. He did not think that fish two feet deep on a surface kept at a temperature of 32° would cool through for some considerable time, and his reason for saying so was that some of the fish put in the cool chamber were so placed in the boxes as they were received, and it was found that those in the centre did not cool for some considerable time. If air which could get into the interstices of the fish could not get at them sufficiently to cool them down, he did not think the heat would pass along through the fishes' bodies quickly enough to cool them in moderate time. It seemed to him,

in order to bring fish from great distances, it was absolutely necessary to freeze them, but merely for bringing them from the trawlers to the market the cooling could be accomplished by cold-air machines, which might be made to occupy a very small space fixed against the bulkhead of a ship, and would require very little attention. With regard to the fish not looking well after they were thawed, he could bear testimony to the fact that nobody, except perhaps an expert, could tell the difference between a fish which had been frozen and one which had not.

Dr. RAE said if any one wished to see specimens of frozen fish they could easily gratify their curiosity in the Exhibition by visiting the Hudson's Bay Company's exhibits. He had only just been looking at them, and thought they quite bore out what was said by the last speaker, for no one hardly would suppose the fish had been frozen, and those who ate them could not tell the difference. He was not now speaking of common kinds of fish, but of salmon, though in one part of the Hudson's Bay territory the whole people lived on frozen fish for a considerable time. All the men in the employ of the Company on the Makintz River were fed on this, and it was one of the best diets they had, though they ate them without bread or potatoes. He had lived there several years himself, and had had but little else than fish to eat. They could even notice the distinction between meat-eating and fish-eating men on seeing them together. The men who lived on animal food altogether, as used to be the case in the old buffalo days, had a more dried-up look; they worked well, but they had not the wholesome fresh look that the fish-eating men had. He was certainly convinced that fish was not injured seriously by being frozen, for it was kept there many months in that state.

Sir AMBROSE SHEA then proposed a vote of thanks to Mr. Kilbourn, to whom they were greatly indebted for having put forward the Paper, which had elicited so much interesting discussion. He had listened with a great deal of interest to the observations of Mr. Alward, who put forward some views calculated to shake faith in the entire efficacy of the means proposed in the Paper, but it was only through the interchange of conflicting opinions that the object they all aimed at could be effectually accomplished. He believed the great object should be to endeavour to preserve fish without freezing. Several gentlemen who appeared to be well informed on the matter seemed to be of opinion that frozen fish were not injured, but from his little experience in the matter he came to a very different conclusion. A great deal, however, would depend upon the length of time during which the fish was preserved frozen. Still, he believed the great aim should be to avoid the necessity for freezing, and to devise some means by which the temperature could be uniformly preserved somewhat above the freezing-point. They knew that meat was brought across the Atlantic perfectly sound and good at a temperature above the freezing-point, and, although Mr. Alward admitted that, yet he appeared to bring forward very good reasons why there were practical difficulties in the way of applying the same means to the preservation of fish as they were caught in boats round the coast. He could not but express his regret that these Conferences were so thinly attended, but this might arise partly from the difficulty which some might have in coming a long distance to attend, and partly from the feeling that in due time all these Papers would find their way into the public press, where all would have an opportunity of perusing them. He believed they were a very important

adjunct to the Exhibition, and would materially aid in carrying out the great objects for which it was established.

Major SEWELL GANA seconded the motion.

Mr. ALWARD, not only individually, but as representing a large body of persons connected with the North Sea fisheries, begged to support the motion most cordially.

The CHAIRMAN, (Mr. Wilmot), in putting the resolution, said he held in his hand a slip from a newspaper to the effect that some thirty-five tons of fish were thrown aside in the London market the other day as being unfit for food, yet at the same time thousands of poor people were on the point of starvation for want of food. Surely some means ought to be provided whereby such a state of affairs could be prevented. He believed this was largely brought about by avarice and greed upon the part of the fishermen in catching more fish than was necessary to supply the market, and the fish dealers allowing overstocks of fish to spoil rather than sell them at reduced prices to the poor; too many were taken, they were brought to shore and, without proper supervision, were sent off, and in many cases became unfit for food before they reached their destination. In Canada, fish were caught in the great Western Lakes in great quantities. They were put on board of little steam-tugs in refrigerating boxes, and conveyed, perhaps, 100 or 200 miles to the nearest harbour or railway station. The boxes were then put on the railway car and went on in some instances 1,000 or 2,000 miles, and were sold as fresh fish, and were eaten as readily as those caught within a few miles of the market. He had been struck with astonishment that within the area of this small island, as it was compared with Canada, similar means were not introduced, instead of having so many fish spoilt.

Not only were the fish taken to market, but they remained in the cellars of the dealer for a week or ten days after they arrived there. The process was very simple ; the fish were taken out of the water in tons weight ; on deck were a number of boxes, of which a specimen could be seen in the Canadian Court, forwarded by Mr. Leckie of Toronto, each box holding about two tons. It was packed round the outside with non-conducting material ; a layer of finely-powdered ice was put in the bottom, then a layer of fish, then another layer of ice, and so on until there were fifteen or twenty layers of fish and ice, and it was then shut down tight and sent off. He need hardly say that, if the fish were not in good condition, the inhabitants of the great cities in the United States would not eat them. He had often eaten this fish in the best hotels in Toronto, and it was difficult to distinguish them from fish caught in the bay in front of the city. If some similar mode were adopted here, they would not hear of fish coming to the London market and being condemned the next day as unfit for human food. It was said by some person that frozen fish were not fit for food, but he could contradict that *in toto*. The fish he had previously been speaking of were principally white fish, pickerell, pike, sturgeon, and fish of that order ; but he would now say a word or two with regard to salmon. This was caught in large numbers in the Canadian rivers. This year there had been so plentiful a supply that they had been unsaleable at a remunerative price, and large quantities were immediately frozen. Since he had been over here he had written to dealers in Canada to have some of this frozen salmon sent to England, but the reply he got was that they could not do so, as they were under contract for all their fish to be delivered next January, February, and March in New York, Boston

and Philadelphia. Now, if in Canada they caught fish in June, July, and August, and froze them up, and the fish dealers in New York and Boston would buy them for delivery early next year, it was evident the fish could not be very much deteriorated by freezing. He had eaten those fish for several years past, and it was the regular custom to have it on Christmas Day, when, the waters being frozen, of course it was impossible to catch fresh fish, but they were considered as good then as when caught in June. There might possibly be a very slight difference in the quality, but that was not the question. Fish could be preserved in this way so as to form food for the greater portion of the people, and if those who cultivated more fastidious palates were not satisfied with it they need not eat it. It seemed to him a burning shame that so much fish should be thrown away as unfit for food when there were evident means of preserving it. In the Canadian Court there were specimens of fish caught in June 1882, which had been kept in the frozen state up to the present time. A fortnight ago one of those cases was opened and some fish taken out, and they were so hard they had to be sawn in slices. He took a piece home and had it cooked, and it certainly was very good, but perhaps to the epicure not so delicate as a piece he might have bought in the market; but it was delicious food, fit for any one to eat, and he certainly thought the more frozen fish they could get the better. The vote of thanks was then carried.

Mr. KILBOURN, in reply to the remarks made, said: Mr. Cornish will see, when he has an opportunity of reading the Paper, that he has not in all respects rightly interpreted my views as to the value of preservation by freezing. Instead of protesting against the practice of absolutely freezing, I most emphatically endorse it, where it is neces-

sary to extend preservation over considerable periods of time.

I am well aware that many object to this method of preservation, believing that freezing impairs the flavour, but if any one entertaining this belief will take two fish as soon as caught and killed, pack one in ice and freeze the other, and keep them in these respective conditions a given length of time, it will be found that the frozen fish, when cooked, is in every essential particular equal to the one packed in ice; and if preservation extends beyond a very brief period the frozen fish will be the best.

Preservation by retardation, if properly carried out, may be made to extend over a sufficient period to meet the present requirements of the English fishermen, and if the business should come to that stage of development where freezing in a measure supercedes curing for the surplus stock, then the preliminary operations requisite for the retarding process would be quite suitable and necessary as preliminary to freezing, which, for economical reasons and others, will be mainly done on shore.

The fears expressed by Mr. Alward and Sir Ambrose Shea that the method outlined in the Paper read would be impracticable for the North Sea fisheries are, it is believed, altogether groundless. It is true that the attempts alluded to that have been made to solve this great problem were complete failures, but the reasons therefor were manifest, and I predicted the result before the trials were made. The theory of all putrefactive action, as set forth in the Paper read, is well established, and when clearly comprehended it will illuminate the course necessary to take. The system of preservation outlined does not require new invention for its complete development but rather a judicious application of discoveries already made; neither is it confined to any particular

method or machine for producing the cooling power, nor based on hard-and-fast lines which cannot be varied, but may be adapted in a practical manner to either smack, cutter, or railway van.

It would be discreditable if not disgraceful not only to artizan but capitalist, if a system that has been proved over and over again equal to bringing mutton from Australia and salmon from Canada and Labrador in a frozen state, and beef from Chicago to London (more than four thousand miles) in an unfrozen state, cannot find such application on boats and vans as will keep fish in a sound condition while in transit from any part of the English coast to the various English markets.

Mr. MACKIE proposed a vote of thanks to the Chairman, who had been so regular in his attendance at these Conferences, and had conveyed so much useful information to those who attended.

The motion was seconded by the Chevalier BICKER-CAARTEN, and carried unanimously.

The CHAIRMAN, in reply, said it was very gratifying to him to find that his remarks had been received with approbation. One of the main points which he had endeavoured to impress upon those who attended those Conferences was, that if the present destruction of fish went on unchecked, the time would come when the supply would be entirely exhausted.

NOTE.—Since the above discussion took place Mr. Wilmot has taken some of the salmon frozen in June 1882 out of the Canadian Freezers on exhibition, and presented them to persons of high distinction in London. In dining with one of these, the salmon when served up was not distinguishable by the host or his guests from fresh-caught fish.

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